

[Claim 8] A separator of claim 1 which has a sucking height in a range as shown by the following inequality (1):

$$0.7 < h^2\eta/\gamma t \quad (1)$$

5

wherein  $h$  denotes the height (mm) to which a liquid is sucked up within a period of  $t$  seconds;  $\eta$  denotes the viscosity (mP a S) of said liquid;  $\gamma$  denotes the surface tension (mN/m) of said liquid; and  $t$  denotes sucking time (second).

10

[Claim 9] A process to manufacture a separator of claim 1 which is characterized by the following steps: at least one substance selected from said ionic substances, hydroxyl group-containing substances and silicon compounds is previously dissolved or  
15 dispersed in water; subsequently, an uncoated separator is soaked in the resultant solution or dispersion; and then, said separator is dried so that moisture may be evaporated.

[Claim 10] A process of claim 9 which is characterized by the  
20 following steps: an uncoated separator is previously integrated with a part before soaked in a solution; subsequently, thus assembled whole part is soaked in a solution; and then said whole part is dried so that moisture may be evaporated.

25 [Claim 11] Electrical and electronic parts wherein a separator of claim 1 is used.

[Detailed Description of the Invention]

[0001]

30 [Technical Field to which the Invention belongs]

This invention relates to a coated separator, process for the production of the same, and electrical and electronic parts in which the same is used.

[0002]

[Prior Art]

As is symbolized by the recent progress of portable communication equipments, high-speed processors and the like, it is remarkable that electronic equipments have now smaller size and less weight and give higher performance than before. One of elementary techniques that contribute to this tendency is the improvement of electrical and electronic parts in performance. Batteries are no exception; high-performance parts for batteries are being rapidly developed. There is accordingly a growing demand for the development of technology and quality of members, e.g., separator as an interstructure.

[0003]

For instance, as a variation of alkaline batteries, a cylindrically shaped one is known. This cylindrical alkaline battery is manufactured by winding a separator onto a group of grids. In order to increase battery capacity or to reduce electric resistance, non-woven fabric which is used as a separator needs to have a good electrolyte retention. For this purpose, a separator is preferably composed of fibers which have as small a diameter as possible. In one of known methods to produce such non-woven fabric, water stream is sprayed on a fiber web which contains divisible fibers which comprise polyolefin resin and are divisible with water stream, by which to divide the divisible fibers and thereby produce fibers having a small diameter. This method has a problem that divisible fibers cannot be divided sufficiently, or that a large amount of energy is required so that fibers may be fully divided.

[0004]

[Problems to be solved by the Invention]

The objective of this invention is to overcome the above-mentioned problem, i.e., to provide a separator which has a good electrolyte retention.

[0005]

[Means to solve the problems]

In consideration of the above-mentioned situation, the inventors of this invention have made assiduous study with a view to developing a separator which has a high-level electrolyte retention, and, thus, accomplished this invention.

5 [0006]

This invention provides a separator for electrical and electronic parts which is coated with at least one substance selected from ionic substances, hydroxyl group-containing substances and silicon compounds.

10 [0007]

This invention also provides a process to manufacture a separator as mentioned above, which is characterized by the following steps: at least one substance selected from ionic substances, hydroxyl group-containing substances and silicon  
15 compounds is previously dissolved or dispersed in water; subsequently, an uncoated separator is soaked in the resultant solution or dispersion; and then, said separator is dried so that moisture may be evaporated.

[0008]

20 This invention further provides electrical and electronic parts such as battery and capacitor wherein a separator of this invention as mentioned above is used.

[0009]

In the following, the capacitor of this invention, a process to  
25 manufacture the same, and the use of said capacitor are explained in more detail.

[0010]

[Mode for carrying out the Invention]

(Separator)

30 In this invention, "separator" is defined as a structure to separate conductive members, e.g., electrodes, from each other in electrical and electronic parts such as battery and capacitor, for the purpose of preventing short circuit. Separator is usually employed in the form of paper, non-woven fabric, fine porous film or a

composite thereof, which are not restrictive.

[0011]

As a material for separator, there are often used aramid, polyester, polypropylene, polyethylene, polyphenylene sulfide, fluoroplastic, polyvinyl alcohol, PBO (poly-para-phenylene benzobisoxazole), polyimide, glass, carbon, alumina, natural fiber and natural pulp, since these materials are easy to process into paper, non-woven fabric or fine porous film. There is however no particular restriction on materials insofar as they have higher resistance than electrode or the like in electrical and electronic parts.

(Coated separator)

In this invention, "coated separator" means a separator whose surface has, adhered thereon, at least one substance selected from ionic substances, hydroxyl group-containing substances and silicon compounds. There is no particular restriction on the amount of said substance adhered, to the extent that pores of separator are not substantially clogged. Generally, however, said amount preferably falls within a range of 0.004—20 % based on the weight of uncoated separator. Although uniform coating is desirable, uneven coating causes no problem if only separator functions as such.

[0012]

There is no restriction on coating methods. In a suitable method, the above-mentioned substance is dissolved or dispersed in water; subsequently, a separator is soaked in the resultant solution or dispersion; and then, said separator is dried so that moisture may be evaporated. In another method, an uncoated separator is previously integrated with a part before soaked; subsequently, thus assembled whole part is soaked in solution or dispersion; and then, said whole part is dried so that moisture may be evaporated. The condition of the above-mentioned drying is not particularly restricted. Usually, however, drying is preferably conducted at a

temperature of 50°C or higher for one minute or more.

[0013]

The above-mentioned "part" means an electrical and electronic part such as battery and capacitor. Such parts include  
5 both finished articles and semi-finished ones so long as they have a space permeative with the above-mentioned solution.

(Ionic substances)

"Ionic substances" which are used in this invention mean  
10 substances wherein compound-constituting chemical bond contains ionic bond. Concrete examples include calcium carbonate, calcium chloride, anhydrous calcium chloride, calcium oxide, sodium chloride, sodium sulfate, anhydrous sodium sulfate, sodium sulfite, copper sulfate, anhydrous copper sulfate, aluminum sulfate and  
15 sodium carboxymethylcellulose, which are not restrictive.

(Hydroxyl group-containing substances)

"Hydroxyl group-containing substances" which are used in this invention mean substances which contain a hydroxyl group  
20 (—OH) in compound. Concrete examples include alcohols (e.g., ethanol, butanol, etc.), glycols (e.g., ethylene glycol, propylene glycol, etc.) and polysaccharides (e.g., cellulose, starch, etc.), which are not restrictive.

25 (Silicon compounds)

"Silicon compounds" which are used in this invention mean compounds which contain silicon. Concrete examples include silica gel, silica sol, silica and zeolite, although these are not restrictive.

30 (Heat treatment)

In this invention, under circumstances, separator is subjected to heat treatment before and/or after coated, for the purpose of further improvement of electrolyte retention. In particular when a heat treatment is conducted after coating, ionic

substance, hydroxyl group-containing substance or silicon compound or the like is fixed on separator with the result that electrolyte retention may possibly be enhanced. There is no strict restriction on temperature of said heat treatment. Generally,  
 5 however, the temperature is preferably not higher than the melting point of separator-constituting material.

#### (Electrolyte retention)

In this invention, "electrolyte retention" means the extent to  
 10 which a separator sucks up a liquid such as electrolyte within a certain period of time. Concretely, it is defined as a value which is calculated according to the following formula (2):

[0014]

$$h^2\eta/\gamma t \quad (2)$$

15

wherein h denotes the height (mm) to which a liquid is sucked up within a period of t seconds;  $\eta$  denotes the viscosity (mP a S) of said liquid;  $\gamma$  denotes the surface tension (mN/m) of said liquid; and t denotes sucking time (second).

20 [0015]

Generally, the electrolyte retention of the coated separator of this invention as shown by the above-mentioned formula (2) is more than 0.7.

[0016]

25 The separator of this invention which has been coated in the afore-mentioned manner has a good electrolyte retention owing to coating, and is quite suitable as a separator panel between conductive members of electrical and electronic parts.

[0017]

30 [Examples]

In the following, this invention is explained in more detail by Example and Comparative Example.

(Method for measurement)

(1) Measurement of the basis weight and the thickness of sheet:

Measured according to JIS C2111.

(2) Measurement of sucking height:

5

The height to which n-butanol was sucked up within a period of 30 seconds was measured.

[0018]

At 20°C, n-butanol had a viscosity of 7 (mP a S) and a surface  
10 tension of 24.6 (mN/m).

Example 1

Fibrid of polymetaphenylene isophthalamide was  
manufactured with a wet type precipitator as mentioned in  
Japanese Patent Publication No. Sho 52 (1977)-151624. Thus  
15 obtained fibrid was treated with a refiner so that drainage rate  
(Canadian standard freeness) might become 20 ml.

[0019]

Conex®, manufactured by Teijin Limited was cut to a length  
of 5 mm to serve as paper stock (aramid flock). This flock had a  
20 fineness of 0.8 denier.

[0020]

Thus prepared stock was mixed with each other in water, and  
was then made into sheet with TAPPI standard sheet machine  
(surface area: 625 cm<sup>2</sup>).

25 [0021]

Said sheet was subjected to calendering process with a  
calendering machine at a roll temperature of 330°C, a roll linear  
pressure of 100 kgf/cm, and at a rate of 2 m/min.

[0022]

30 Thus calender-processed sheet was soaked in a 0.25 %  
aqueous solution of sodium sulfate for one minute, and was then  
dried in a hot air oven at 150°C for 30 minutes.

[0023]

Thus obtained sheet material was measured for main

properties and butanol-sucking height. Results are shown in Table 1.

#### Comparative Example 1

5 The steps of Example 1 were repeated up to calendering process, and, then, thus processed sheet was soaked in high purity water for one minute, and was then dried in a hot air oven at 150°C for 30 minutes.

[0024]

10 Thus obtained sheet material was measured for main properties and butanol-sucking height. Results are shown in Table 1.

[0025]

[Table 1]

15

Table 1

Properties	Unit	Example 1	Comparative Example 1
Composition of material	Weight %		
Aramid fibril		10	10
Aramid flock		90	90
Basis weight	g/m <sup>2</sup>	10	10
Thickness	mm	0.04	0.04
Density	g/cm <sup>3</sup>	0.25	0.25
Sucking height	mm	13	8
Liquid retention $h^2\eta/\gamma t$	$\mu\text{m}$	1.6	0.6

[0026]

20 As is seen in the above Table 1, liquid retention is improved when separator is coated in accordance with this invention.



[0027]

[Effect of the invention]

As explained above, a separator which has been coated in accordance with this invention improves in electrolyte retention.

- 5 When used in electrical and electronic parts, a coated separator of this invention is expected to help said parts to show their original electrical properties without such loss as caused by the insufficient retention or leak of electrolyte.